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ABSTRACT

This study investigates relationships among conservation, field dependence/independence, school variables, achievement, screening measures, sex and race. A total of 124 first, second and third graders in a Southern rural school were administered 8 typical Piagetian conservation tasks (PCT), Children's Embedded Figures Test (CEFT), Comprehensive Test of Basic Skills (CTBS) and First Grade Screening Test (FGST). Results indicated a positive relationship (r=.50) between scores on conservation (PCT) and field independence/dependence (CEFT). Students who scored higher on the Piagetian conservation measures scored higher in field independence. They also scored higher on achievement measures (CTBS). The findings on sex differences indicated that girls scored higher than boys on the conservation tasks (PCT), in achievement (CTBS), and in field independence (CEFT), though the latter difference was not statistically significant. Analysis of differences due to race showed that white students scored significantly higher on the conservation tasks (PCT), on field independence (CEFT) and on achievement (CTBS) than black students. However, there was no significant difference between black and white students on IQ as measured by the FGST. (Author/SS)

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Relationship between Field Dependence - Field Independence, Piaget Conservation Tasks and School Variables

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The relationship between nonconservers/conservers and field dependence/field independence with school variables: achievement, screening measure, sex and race was explored. 124 first, second and third graders in a Southern rural school were administered 8 typical Piagetian conservation tasks (PCT), Children's Embedded Figures Test (CEFT), Comprehensive Test of Basic Skills (CTBS) and First Grade Screening Test (FGST). Significant differences in favor of conservers were found between students in the various categories of conservation on the CEFT (FD-FI), FGST and CTBS. ANOVA by cognitive style showed significant differences in conservation, achievement and screening test all in favor of the field independents. Interactions are reported.

Relationship between Field Dependence - Field Independence, Piaget's Conservation Tasks and School Variables

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Statement of Problem:

The study explores the relationships between nonconservers/conservers and field dependence/field independence with school variables: achievement, screening measures, sex and race.

Perspective(s) or Theoretical Framework:

Despite the popularity of Piagetian psychology in studies of learning, the relevance of this theory to teaching and achievement in schools has often been contested. There is a paucity of studies in the literature that would establish its meaningfulness to school achievement. Almy, Chittenden and Miller (1966) found moderate correlations (r = .37 and .39) between a measure of conservation and a measure of reading readiness in kindergarten children and with a measure of reading (r = .37 and .39) in second grade children. In addition, Briggs and Elkind (1973) found that readers as compared to nonreaders were significantly superior on conservation tasks. De Vries (1974) found correlations between Piagetian tasks and the Metropolitan Achievement Tests, Reading (MAT-R) to be low ranging from .01 to .33. Orpet, Meyers and Grein (1976) also found a nonsignificant r of .13 between a measure of liquid conservation and the Stanford Achievement Test. Taken altogether, the studies have yielded inconsistent relationships as evidenced by substantial correlations as found in the Almy et. al. (1966), Kaufman and Kaufman (1972) studies and essentially the absence of any relationship in the

De Vries (1974) and Orpet et. al. (1976) studies.

Although there are also some inconsistencies, a positive correlation between conservation and mathematics and the sciences seems to be indicated. Wollman (1977), for example, suggested in a study with three math classes that performance on a Piagetian task improves with math ability and with grade. Sayre and Ball (1975) found correlations of .33 and .46 between Piagetian tasks and science grades for junior high and high school students, respectively.

From a structural point of view, conservation tasks resemble Witkin's field-independence-dependence tasks. According to Case and Pascual-Leone (1975) failure in conservation tasks may be related to field dependence. Field dependence (FD) and field independence (FI) are cognitive styles originally described by Witkin in 1949 and extensively researched (1977).

A correlation between the FI dimension and various Piagetian tasks has been demonstrated (Case and Pascual-Leone, 1975; Willemsen, Buckholz, Budrow and Geannacopulas, 1973; and Fleck, 1972).

Witkin (1977) cited numerous studies that demonstrated a lack of any relationship between the FD-FI dimension and achievement at the college level, moderate relationships at the high school level and a definite relationship at the elementary school level (Cropley, 1966; Erginel, 1970; Frederick, 1967; Wagner, 1974).

Method:

Sample:

The sample consisted of 124 students in grades one, two and three in a Southern rural elementary school. Students in each grade were

grouped into three sections by ability. The student assignment was made by the principal based on recommendations of the kindergarten teachers and the results of the First Grade Screening Test or Boehm Test of Basic Concepts. All first grade sections were included in the study and every third student in grades two and three.

There were 58 boys and 66 girls. Sixty-six of the students were white and 58 were black. The total number of students was 124. Two first graders were omitted from the sample because parents did not sign the permission; two others could not participate because of handicaps.

Instruments:

Instruments used were the Children's Embedded Figures Test (CEFT), Piaget's Conservation Tasks (PCT), Comprehensive Test of Basic Skills (CTBS), the First Grade Screening Test (FGST) for first and second grades and the Boehm Test of Basic Concepts for the third grade.

The results of the CEFT, Tent Version, were used to classify children as field dependent (FD), mixed (FD-FI) or field independent (FI).

The PCT consisted of 8 tasks, 2 on conserving liquids, 2 on conserving mass, 2 on conserving number and 2 on conserving weight.

Two points were awarded for each task: one for the correct answer and one for the correct rationale. Results of this instrument were used to classify students as nonconservers, transitional or conservers. The tasks were assembled by the investigators consistent with typical Piagetian conservation tasks.

Achievement was measured by the CTBS, Form S, Level B, which was

administered at the end of each grade.

First grade placement was determined by the FGST which was administered during the first two days of school to all first graders and by recommendations of kindergarten teachers for those who had attended kindergarten (90% of 76 first graders). The FGST was also used to classify second graders when they entered first grade. The Boehm Test of Basic Concepts was used to classify third graders when they entered grade one.

Procedures:

Prior to the testing on the CEFT and PCT by the investigators, the FGST (or Boehm in case of third graders) and the CTBS had been given by school personnel. The screening test (FGST or Boehm) was one of the determinants of placement by ability and was given in August before each child entered the first grade. The CTBS was to measure achievement at the end of each grade and was administered in April. During the last of April and May the investigator individually administered the CEFT and PCT to students in the sample.

Students were classified as field dependent (FD) if their score on the CEFT was from 0 to 3; mixed (FD-FI) if their scores were from 4 to 6; field independent (FI) if their scores were from 7 to 11.

On the Piaget Conservation Tasks (PCT) students were classified as nonconservers if their scores were from 0 to 4, transitional from 5 to 10 and conservers from 11 to 16.

Data were analyzed by computer using the Statistical Analysis System (SAS). Correlations, stepwise regression, means and analyses of variance were computed.

The results were divided into six sections. The first section reports the general descriptive data; the second, the results by conservation category; third results by FD-FI classification; fourth results by sex; fifth by race; and the last, interaction effects.

Results:

Descriptive Data:

Means and standard deviations of the four measures for the total sample and each grade are reported in Table 1. An increase in scores across grade is noted for FD/FI and achievement (CTBS). Second graders scored slightly higher on conservation than third graders. The increase in conservation as students progress upward has been established in prior research. The developmental aspect of FD/FI has not been as clearly established.

Insert Table 1 About Here

Conservation:

There were significant differences between students in Piagetian categories on CEFT, screening test, CTBS and IQ. (See Table 2.) The correlations between PCT and CEFT were significant for the total sample, first grade and third grade. (See Table 3.) Sex was not a significant variable when the two-way analysis of variance by Piagetian category and sex was computed. Only category was significant.

Insert Tables 2 and 3 About Here

Race as well as Piagetian category was significant on CEFT, screening test and the CTBS when a two-way analysis was computed by Piagetian category and race. There was no significant interaction between Piagetian category and sex or race. (See Tables 4 and 5.)

Insert Tables 4 and 5 About Here

Two-way analysis of variance by Piagetian category and FD/FI category showed each to be significant on the CTBS and the screening test but with no significant interaction. (See Table 6.) Only conservation category was significant for IQ of third graders. Only one conserver was field dependent.

Insert Table 6 About Here

Field dependence/Field independence:

Analysis of variance between the group classed as field dependent (FD, score 0 - 3), FD/FI group (FD/FI, score 4 - 6) and field independent (FI, score 7 - 11) showed significant differences in conservation (PCT), achievement (CTBS) and the placement test (FGST or Boehm), all in favor of the field independent group. (See Table 7.) IQ was not significantly different for third graders in the three classifications on the FD/FI dimension.

Insert Table 7 About Here

Sex:

Means by sex are found in Table 8. Third grade boys scored slightly higher than girls on IQ but the difference was not significant.

Analysis of variance by sex showed a significant difference between boys and girls on conservation tasks. The girls scored higher on conservation tasks than the boys.

Insert Tables 8 and 9 About Here

In the Piagetian categories, 3% of the boys and 10% of the girls were conservers. More girls were transitional than the boys and 23% of the boys were nonconservers compared to 17% of the girls.

There was a significant difference in achievement (CTBS) in favor of the girls. (See Table 9.) Girls scored higher (more field independent) on the CEFT than boys but the difference was not statistically significant. This is contrary to previous research (Witkins, 1977) which showed boys more field independent than girls.

About the same number of boys as girls were FD and more girls were FI than boys. Previous research showed more FD girls.

Race:

Means by race are found in Table 8. Mean differences are easily noted.

Analysis of variance showed that white students scored significantly higher on the CEFT, conservation tasks, (PCT) and achievement (CTBS) than black students. (See Table 10.) These results are also

consistent with previous research.

That there was no significant difference on IQ is contrary to the literature and surprising in view of a 14 point spread between means. Large within group differences overshadow between group differences.

More black than white students were nonconservers in the first grade; about the same percent of black and whites conserved. The number of conservers increased in the second grade and third grade with more whites conserving in grade three.

On the FD-FI, about the same number of blacks and whites were field independent, but there were three times as many blacks who were field dependent as whites.

Interactions:

Interactions of conservation status and sex and conservation status and race have been reported. None are statistically significant.

Interactions of field dependent/independent and sex and field dependent/independent and race have also been reported. None are statistically significant.

As reported in an earlier section there was no significant interaction between conservation and FD/FI. (See Table 6.) The mean CTBS scores for students in the three conservation categories by their FD/FI categories are shown in Figure 1.

Insert Figure 1 About Here

Discussion:

A positive relationship (r = .50) between conservation category (PCT) and cognitive style (CEFT) was found. Students who were cognitively developmentally advanced over other students scored more field independent. They also scored higher on achievement measures. (See Figure 1.) Thus students who were conservers tended to be field independent and high achievers. The reverse was also apparent in the data. These results raise the question of which of the variables, if any, causes the outcomes on the other variables. Additional research will have to explore this issue. One might ask if all of these might not be the result of an additional but unmeasured variable, namely, that of intelligence of g factor (in a more traditional definition of intelligence). Witkins et. al. (1977) has reported a low positive relationship between intelligence and FD/FI but he believes there is no difference in the learning ability between FD's and FI's but a difference in their psychological differentiation. The investigators are currently collecting additional conventional intelligence score data on the sample.

Sex and race variables were also explored in relation to conservation and FD/FI and achievement. The findings on sex and race differences for the variables were generally consistent with previous studies with the exception of the girl's mean score on the CEFT; it was higher than the boy's mean score. This is inconsistent with past research which reported boys as more field independent than girls. If cognitive style is another dimension or g factor, the higher mean score for girls would be consistent with the studies

on achievement and intelligence which have shown girls in the early grades score higher than boys on such measures.

White students who are more field independent and are conservers do better on achievement measures than those who are black, field dependent and/or nonconservers.

The CEFT and PCT contributed 39% of the variance in achievement. Teachers who assess student's cognitive style and conservation category and plan curriculum consistent with these, may be able to help students to achieve at a higher level. The results of such intervention was not found in the literature. Efforts to train students to be more field independent or to advance their level of conservation attainment have been reported with varying success.

Perhaps training to change the child's category on the FD/FI dimension or level of conservation attainment is not where significant results will be attained. Appropriate educational experiences at the student's cognitive level and consistent with his/her processing style may be the more rewarding approach.

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Table 1

Means and Standard Deviations of Variables
for Total Sample and By Grades

	Total Group n=124	Grade 1 n=72	Grade 2 n=25	Grade 3 n=27
FD/FI	5.58	4.86	6.40	6.74
	(2.37)	(2.27)	(2.14)	(2.19)
Conservation	6.31	4.76	8.72	8.22
	(3.94)	(3.38)	(3.93)	(3.22)
CTBS	268.15	205.19	319.72	383.63
	(101.36)	(58.81)	(51.64)	(45.36)
Placement	20.95		19.14	37.28*
	(10.09)		4.34	8.59
IQ	-	-	-	99.86
				25.99

*Different Placement Test

Table 2

Analysis of Variance for Variables by Conservation Group

Measure	N	DF	F	P
FD/FI	123	2	17.24	.0001[c]
Placement	100	2	13.34	.0001[c]
CTBS	121	2	19.98	.0001[c]
IQ*	27	2	4.43	.0225[a]

a = $p < .05$
c = $p < .001$
*third grade only

Table 3

Correlation of Variables for Total, First, Second and Third Graders

Variable	Sample	N	Conservation	CTBS	Placement	IQ*
FD/FI	Total	124	.50[c]	.54[c]	.48[c]	
	1 grade	72	.45[c]	.39[c]	.51[c]	
	2 grade	25	.20	.62[b]	.38	
	3 grade	27	.54[b]	.51[b]	.46[c]	.56[b]
Conservation	Total	124		.54[c]	.49[c]	
	1 grade	72		.35[b]	.48[a]	
	2 grade	25		.37	.40	
	3 grade	27		.42[a]	.55[a]	.41[a]
CTBS	Total	124			.75[c]	
	1 grade	72			.43[c]	
	2 grade	25			.53[b]	
	3 grade	27			.69[b]	.90[c]
Placement	3 grade	27				.57[b]

Note: a = $p < .05$
b = $p < .01$
c = $p < .001$
*third grade only

Table 4

Two-Way ANOVA by Conservation (PCT) Groups and Sex

	N	DF	F	P	Variable	DF	F	P
FD/FI	123	5	7.05	.0001[c]	PCT	2	16.99	.0001[c]
					Sex	1	.04	.8383
					PCT*Sex	2	.60	.5482
Placement	100	5	5.64	.0002[c]	PCT	2	13.18	.0001[c]
					Sex	1	1.20	.2768
					PCT*Sex	2	.31	.7321
CTBS	121	5	9.25	.0001[c]	PCT	2	20.39	.0001[c]
					Sex	1	2.39	.1247
					PCT*Sex	2	1.54	.219
IQ*	27	4**	2.41	.0788	PCT	2	4.27	.0265[a]
					Sex	1	.39	.5394
					PCT*Sex	1	.70	.4124

a = p < .05
b = p < .01
c = p < .001
*third grade only
**no transitional males

Table 5

Two-Way ANOVA by Conservation (PCT) Groups and Race

	N	DF	F	P	Variable	DF	F	P
FD/FI	123	5	11.06	.0001[c]	PCT	2	19.22	.0001[c]
					RACE	1	12.87	.0005[c]
					PCT*RACE	2	2.01	.1391
Placement	100	5	13.26	.0001[c]	PCT	2	17.26	.0001[c]
					RACE	1	31.34	.0001[c]
					PCT*RACE	2	.22	.8047
CTBS	121	5	12.67	.0001[c]	PCT	2	22.54	.0001[c]
					RACE	1	16.36	.0001[c]
					PCT*RACE	2	.95	.3888
IQ*	27	4**	2.59	.0638	PCT	2	4.36	.0247[a]
					RACE	1	.69	.4141
					PCT*RACE	1	.92	.3462

a= p < .05
c= p < .0001
*third grade only
**no black transitional subjects

Table 6

Two-Way ANOVA by Conservation Groups and FD/FI Groups

	N	DF	F	P	Variable	DF	F	P
Placement	100	7	5.16	.0001[c]	PCT	2	13.83	.0001[c]
					FD/FI	2	3.80	.026[a]
					PCT*FD/FI	3*	.32	.8126
CTBS	121	8	7.25	.0001[c]	PCT	2	21.49	.0001[c]
					FD/FI	2	6.85	.0016[b]
					PCT*FD/FI	4	.32	.8607
IQ	27	6**	1.67	.1788	PCT	2	4.06	.0324[a]
					FD/FI	2	.57	.5766
					PCT*FD/FI	2	.38	.6908

a= $p < .05$
b= $p < .01$
c= $p < .001$
*third grade only
**

Table 7

Analysis of Variance for Variables by FD/FI Group

Measure	N	DF	F	P
conservation	123	2	11.72	.0001[c]
placement	100	2	10.19	.0001[c]
CTBS	121	2	15.58	.0001[c]
IQ*	27	2	1.47	.249

c = p < .001
*third grade only

Table 8

Means and Standard Deviations by Sex and Race

	Sex		Race	
	Male n=58	Female n=66	White n=66	Black n=58
FD/FI	5.29 (2.33)	5.83 (2.40)	6.44 (2.46)	4.60 (1.85)
conservation	5.40 (3.61)	7.12 (4.06)	7.68 (4.25)	4.76 (2.87)
CTBS	243.80 (91.03)	290.14 (105.84)	332.71 (70.83)	221.21 (76.95)
placement	18.48 (8.59)	23.02 (10.83)	25.84 (9.46)	14.35 (6.58)
IQ*	102.22 (16.81) n=9	98.74 (29.73) n=19	104.26 (28.91) n=19	90.56 (16.02) n=9

*third grade only

Table 9

Analysis of Variance
for Variables by Sex

Measure	N	DF	F	P
FD/FI	124	1	1.61	.21
conservation	124	1	6.17	.01[b]
placement	101	1	5.29	.02[a]
CTBS	122	1	6.63	.01[b]
IQ*	28	1	.11	.75

Note: a = $p < .05$
b = $p < .01$
*third grade only

Table 10

Analysis of Variance of Variables
by Race

Measure	N	DF	F	P
FD/FI	124	1	21.58	.0001[c]
conservation	124	1	19.59	.0001[c]
placement	101	1	46.73	.0001[c]
CTBS	122	1	26.95	.0001[c]
IQ*	28	1	1.75	.10

Note: c = $p < .001$

*third grade only

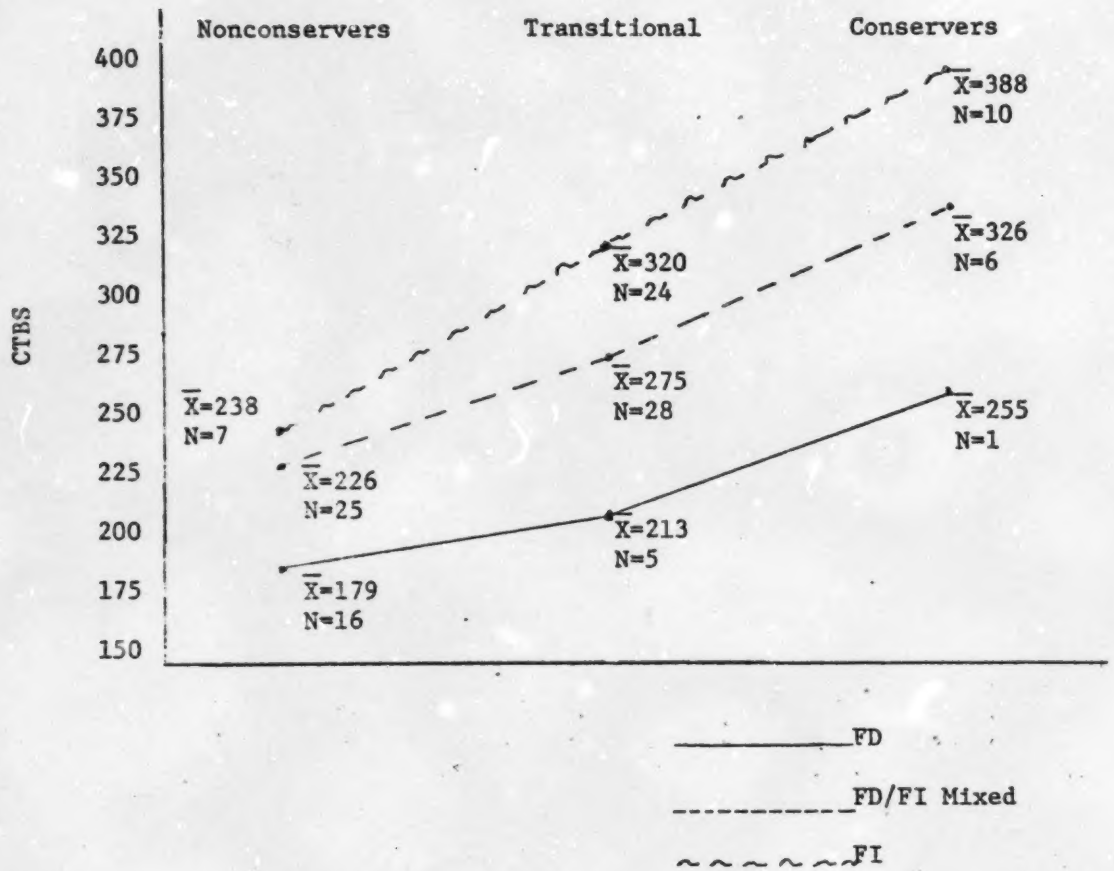

Figure 1
Mean CTBS Scores for Three Categories of FD/FI who were in each of three Piagetian Categories.